density material that is substantially CSH in tobermorite form. Further details are described in U.S. patent application Ser. No. 09/058,444 filed Apr. 9, 1998, the entirety of which is hereby incorporated by reference. Relative to the control, the decreases in density for Formulations M and O are not significantly different, but the total addition of low density additives with the blend (Formulation O) is 3% less than formulation M with only microspheres. For Formulations M and O, the subtle differences in wt. % of hydraulic binder and aggregate do not have an impact on density properties.

TABLE 16

Density Comparisons

Formula Identification	Description	O.D. Density (g/cm^3)
B	Control- No LDA	1.31
M[1]	12% Microspheres	1.09
O[1]	6% Microspheres 3% Low Bulk Density CSH	1.11

[1]The percent LDA in Formulations M and O replace an equivalent percent of aggregate and/or binder in the control with no LDA, Formulation B.

Table 17 below displays test results of 10"×10" filter-pressed prototype boards with four formulations containing variances primarily only in additions of various low density additives, and a control without any low density additives. Results show that Formulation M with 12 wt. % microspheres reduces density from that of the control from 1.35 g/cm^3 to 1.16 g/cm^3, but Formulation N with 11 wt. % addition of the microspheres/low bulk density CSH (Silasorb from Celite) blend lowers the density further to 1.10 g/cm^3. Moreover, moisture expansion for Formulation N with the 11 wt. % microspheres/low bulk density CSH blend and the control without low density additives is not significantly different at 0.167 and 0.163%, respectively. In comparison, Formulation G with only 10 wt. % low bulk density CSH provides about the same density as Formulation N's 11 wt. % blend, but with a notably higher moisture expansion of 0.197%. The subtle wt. % differences of hydraulic binder and aggregate in the formulations do not have an impact on density or moisture expansion properties.

TABLE 17

Moisture Expansion Comparisons

Formula Identification	Description	O.D. Density (g/cm^3)	Moisture Expansion %
B	Control -No LDA	1.35	0.163 ± 0.02
M	12% Microspheres	1.16	0.156 ± 0.02
N	6% Microspheres 5% Low Bulk Density CSH	1.10	0.167 ± 0.02
G	10% Low Bulk Density CSH	1.12	0.197 ± 0.02

[1]The percent LDA in Formulations M, N and G replace an equivalent percentage of aggregate and/or binder in the control with no LDA, Formulation B.

Conclusions

In general, it will be appreciated that the preferred embodiments of the present invention, more particularly, a fiber-reinforced building material containing additives of volcanic ash, hollow ceramic microspheres, or a combination of microspheres, volcanic ash and/or other additives, have several advantages over the prior art. These materials have a low density compared to conventional fiber cement building products. This enables production of a thicker product (e.g., ⅜" to 1.0") that is lighter and therefore easier to handle, cut, nail and install.

The materials also have improved wet-dry dimensional stability and the building material's durability is improved such that building panels do not excessively shrink and crack. Also, excessive gaps between panels or planks do not open up after changes in humidity or from wet to dry seasons.

With respect to at least the formulations and building products incorporating hollow ceramic microspheres, the materials' freeze-thaw resistance is maintained at lower density, unlike most inorganic density modified fiber cement materials. This gives these materials good durability in climates that experience frequent freezing and thawing conditions.

These materials incorporating microspheres also have improved fire resistance properties because of improved thermal dimensional stability relative to typical low density additives. Thus, the materials are stable in building fires as a building component such that the material can maintain a shield to fire without cracking and falling apart and allowing fire to spread quickly.

The preferred embodiments have applicability to a number of building product applications, including but not limited to building panels (interior and exterior), tile backer board (walls and floors), siding, soffit, trim, roofing, fencing and decking. The embodiments illustrated and described above are provided merely as examples of certain preferred embodiments of the present invention. Various changes and modifications can be made from the embodiments presented herein by those skilled in the art without departure from the spirit and scope of the invention.

What is claimed is:

1. A Hatschek manufactured board, comprising:

about 5%-80% of Portland cement;

about 0%-80% silica;

a plurality of hollow microspheres, said hollow microspheres having a median particle size between 20 to 120 micrometers, wherein the hollow microspheres are dispersed in the Hatschek manufactured board to introduce pores in the board, said hollow microspheres comprising about 62%-65% silica, about 23%-26% alumina, and about 3%-4% iron oxide; and

wherein the hollow microspheres lower the density of the Hatschek manufactured board to less than 1.2 g/cm^3.

2. The Hatschek manufactured board of claim **1**, wherein the density of the Hatschek manufactured board is about 0.9 to 1.1 g/cm^3.

3. The Hatschek manufactured board of claim **1**, wherein the median particle size of the microspheres is between about 80 and 120 micrometers.

4. The Hatschek manufactured board of claim **1**, wherein hollow microspheres comprises about 2% to 90 wt. % of the Hatschek manufactured board.

5. The Hatschek manufactured board of claim **1** further comprising about 0%-30% calcium silicate hydrate.

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